

Influence of 3-N,N-Dimethyldithiocarbamoyl-1-Propanesulphonic Acid on the Kinetics and Morphology During Copper Deposition

Ibro Tabakovic, Steve Riemer, Eric Rydholm, John Rice,
and James Ness
Seagate Technology, 7801 Computer Avenue South,
Bloomington, MN 55435

The influence of 3-N,N-dimethyldithiocarbamoyl-1-propanesulphonic acid (DPS), one of the common additives in commercial acid copper electroplating bath, on the cathodic reduction of cupric ions has been studied by rotating disc voltammetry, cyclic voltammetry and potential step techniques. The DPS additive $[(CH_3)_2NC(S)S(CH_2)_3SO_3H]$ added as a sodium salt was not reducible in 1.8M H_2SO_4 at a Cu cathode. A mass transport controlled oxidation wave was observed at ~ 1.2 V vs. SCE at a Pt anode. The interaction of DPS with Cu(I) and Cu(II) ions in aqueous-acidic media was studied by UV-VIS spectroscopy. The results suggest the formation of a Cu(I)DPS type complex, but the similar interaction with copper (II) ions was not observed. The presence of the DPS additive gave rise to an increased exchange current density and to measured Tafel slopes of -154 mV compared to that of -120 mV for copper sulfate alone. Rotating disc electrode experiments indicate that Cu(I)DPS type complex formed on the copper surface is a key intermediate leading to the brightening. The effect of DPS additive on roughness development of thin copper films was investigated by atomic force microscopy. Generally, the deposits obtained from additive-free solutions are rough and deposition from DPS solution gave rise to smooth surfaces. The roughness of copper films is dependent on the DPS-brighter concentration and the current density used for electrodeposition.